

**NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD**

TREE/SHRUB ESTABLISHMENT

(Acre)

CODE 612

DEFINITION

Establishing woody plants by planting seedlings or cuttings, direct seeding, or natural regeneration.

PURPOSE

To establish woody plants for forest products, provide wildlife habitat, provide long-term erosion control and improvement of water quality, treat waste, reduce air pollution, sequester carbon, conserve energy, and enhance aesthetics.

CONDITIONS WHERE PRACTICE APPLIES

On any area where woody plants can be grown.

CRITERIA

General Criteria Applicable To All Purposes

Species will be adapted to soil-site conditions.

Species will be suitable for the planned purpose(s).

Planting or seeding rates will be adequate to accomplish the planned purpose.

Planting dates, and care in handling and planting of the seed, cuttings or seedlings will ensure that planted materials have an acceptable rate of survival.

Only viable, high-quality and adapted planting stock or seed will be used.

Site preparation shall be sufficient to insure establishment and growth of selected species.

Adequate seed or advanced reproduction needs to be present or provided for when using natural regeneration to establish a stand.

Timing and use of planting equipment will be appropriate for the site and soil conditions.

The acceptability and timing of coppice regeneration shall be based on species present and their age and diameter.

The planting will be protected from adverse impacts from pests, wildlife, livestock damage, or fire.

Each site will be evaluated to determine if mulching, supplemental water or other cultural treatments will be needed to assure adequate survival and growth.

Comply with applicable federal, state, and local laws and regulations during the installation, operation and maintenance of this practice.

Additional Criteria to Provide Erosion Control

On bare or eroding areas such as mine spoil, trees will not effectively control erosion for a period of 5 to 10 years. Establish herbaceous vegetation to control erosion during the time trees need to attain adequate size to produce sufficient ground litter and sufficient root systems to hold the soil. See Appendix 1 for specifications for tree seedling establishment with herbaceous vegetation.

Additional Criteria For Improving Or Restoring Natural Diversity

Species selected will be indigenous to the site and will reflect species composition of the desired stands.

Additional Criteria For Reducing Water Pollution

Use species that are native to the area.

If in a riparian area, use species adapted to local flooding conditions. See Riparian Forest Buffer (391) in Section IV, Kentucky FOTG.

Additional Criteria For Wetland Restoration and Wildlife

Wetland Restoration: Except where hydrologic conditions are limiting, eighty-percent of the species in each field shall be composed of at least 3 hard mast producing species. One of the hard mast species must be from the red oak family and one must be from the white oak family. Species should be selected based on planned hydrologic conditions of the restoration site. Species shall be interspersed to provide diversity. Rows may contain the same species but shall not exceed a maximum of three contiguous rows of the same species. To achieve optimum interspersed, plant at least 2 species per row alternating species within the row. When selecting species groupings in obtaining interspersed, consider the species growth habits, requirements, and shade tolerance. See Appendix 3, group C for inter-planting patterns. See Appendix 4 for a summary of species and growth characteristics.

Planting rates for trees should be between 605 seedlings per acre (approximately 6' x 12' spacing) and 681 seedlings per acre (approximately 8' x 8' spacing). Consider using the 12' row widths for equipment access during post planting management activities. Use the 8' x 8' spacings when it is anticipated that the planting will not receive mechanized post planting treatments.

See Appendix 4 for recommended species for bottomland hardwood restoration plantings.

Wildlife Plantings: The objectives for wildlife plantings are to produce food (nuts, berries, or other fruits) and to provide cover for birds and animals. Use wetland restoration guidance where the objectives are to produce mast. To provide wildlife cover, plant beneficial shrub species at planting rates between 681 seedlings per acre (approximately 8' x 8' spacing) and 1210 seedlings per acre (approximately 6' x 6' spacing). Consider the target wildlife species and objectives in selecting tree/shrub species. See Upland Wildlife Habitat Management (645) for additional guidance. Appendix 4 includes recommended species for bottomland hardwood restoration and wildlife plantings.

Types of Establishment:

Bare-root: Plant large diameter seedlings with well-branched, fibrous root systems. Discard any

diseased or damaged seedlings. For underplanting hardwoods, use stock at least 3/8 inch in stem diameter.

Cuttings: Use cuttings prepared during the dormant season from wood of the previous season's growth. The cuttings should be taken from healthy, moderately vigorous stock plants growing in full sunlight. At least two nodes should be included in the cutting. Cuttings should be at least 1/4 inch and preferably 3/8 to 3/4 inches in diameter. They should be at least 12 inches long and 15 to 20 inches where practical. The top should be horizontal and the bottom should be beveled at a 45 degree angle.

Balled and burlap: Shrub planting stock should be 18 inches or more in height. Tree stock should be 48 inches or more in height. Do not use plants with cracked or broken rootballs. Avoid "pot-bound" plants indicated by root systems that are visible on the rootball surface and that circle the trunk.

Container grown: Containerized stock shall be 3 gallon size (air pruned root stock), with 2 – 6 foot tree height and 3/8 – 5/8" caliper (diameter at ground level at root collar).

Direct Seeding: Use viable, mature seed. Locally collected seed or that purchased from commercial sources may be seeded by hand or mechanical methods. Successful stands have been established by seeding oaks, yellow poplar, pine, and walnut. Some type of site preparation to prepare a bare soil seedbed should be considered to achieve success. Direct seeding should not be considered where the risk of seed predation by birds, rodents, or other mammals is likely.

Natural Regeneration: Sufficient seed trees should be close by to furnish large amounts of seed. Light-seeded species such as ash, cottonwood, maple, pine, and yellow poplar are the best choices for this establishment method.

Adapted Species:

For species selection refer to Kentucky FOTG, Section II, Forest Interpretations, Windbreak Interpretations; practice standards Wildlife Upland Habitat Management (645), Riparian Forest Buffer (391); and "Kentucky Tree Planting Manual" published by the Kentucky Division of Forestry.

Base selection on landowner objectives, soil type, site limitations, and landscape characteristics.

See Appendix 2 for species recommended for planting on mine spoil.

Site Preparation

Based on cover present, follow guidelines in Forest Site Preparation (490), Section IV, Kentucky FOTG.

Site preparation will vary according to the type of ground cover, species to be planted, soil type, slope, equipment limitation, degree of erosion, and other site specific factors. Many sites will not require site preparation.

Care of Planting Stock

Seedlings: Seedlings should be protected from sun and wind during shipping and the planting operation. They should be kept moist during transportation, storage, and during the planting operation. Seedlings should be planted immediately after delivery. If planting will be delayed for more than 5 days, place them in cold storage at 35 to 45 degrees F. If cold storage is not available seedlings should be heeled-in. Spread roots against the back of a trench that is slightly deeper than the root systems. Cover roots with soil and tamp the soil firmly to eliminate air space.

Cuttings: If planting will be delayed, cuttings should be tied in bundles and buried outdoors in moist, well-drained soil or sawdust. Before planting, soak the cuttings in water for one to two days.

Ball and burlap/containerized: Keep the roots moist by watering slowly from the top. Stock can be held temporarily by placing soil or mulch around the ball or container and keeping it moist.

Direct seeding stock: Keep seeds moist and cool. Do not allow the seeds to mold. Seeds can be placed in porous bags to prevent heat buildup.

Planting Dates:

Bare-root and cuttings: Spring planting can begin when the ground is no longer frozen and as soon as planting stock is available. Spring planting usually terminates in western Kentucky by April 15 and in eastern Kentucky by May 1. Fall planting may be done after hardwoods have lost their

leaves and on into winter as weather and ground conditions permit. Fall and winter planted stock is subject to frost heaving and winter kill.

Ball and burlap/containerized: Balled and burlapped or container grown stock shall be planted September 15 to June 1 as local soil and weather conditions permit.

Direct seeding stock: Seed may be planted from November through April anytime that soil and site conditions allow (do not seed on frozen soil). Spring seeding can reduce rodent and insect damage. Fall seeding can eliminate the need for stratification. Acorns of most species in the white oak group have little or no dormancy and should be planted as soon as possible after collection in the fall.

Planting Methods:

Bare-root: Plant seedlings upright at the same depth or slightly deeper (1 inch) than the stock was growing in the nursery or container. Plant seedlings so that the main root is straight down, not doubled up. Properly planted seedlings should resist gentle lifting pressure.

Cuttings: Cuttings of cottonwood and hybrid poplar are commonly planted in Kentucky. The cuttings should be placed in the ground in a vertical position with the large end at the bottom. The smaller end should be flush with the ground or not more than two inches above the ground surface. Leave 2 good buds above ground. Willow cuttings are an excellent choice in bioengineering techniques to stabilize streambanks. Place the willow cuttings lengthwise in a swallow trench and cover with soil.

Ball and burlap/container: dig a hole large enough to hold root ball. Remove plants from containers before placing in the ground. If plants are in tarpaper pots, the tarpaper should be slit along each side or removed before placing in the ground. Place stock at same depth it grew in the nursery and firmly pack soil around roots to eliminate air pockets.

Direct seeding: Use care to completely cover the seed and achieve good soil-seed contact. Acorns should not be planted within 300 feet of an existing woodland to avoid rodent depredation. Seedlings should be planted in these areas. One or more of the following seeding methods should be used.

1. Broadcast: On a well prepared seedbed, broadcast the seed evenly over the planting area and cover seeds with mineral soil (1/2 to 1 inch).
2. Spot: Plant 1 seed per spot, 2 to 3 inches deep. The spots should be 3 to 4 feet in the row to compensate for low germination rates. Cover with mineral soil.
3. Machine: Plant seeds 2 to 3 inches deep every 3 to 4 feet in the row to compensate for low germination rates. Cover with mineral soil.

Natural Regeneration: Mechanical site preparation immediately prior to seed fall to expose mineral soil is required for successful establishment. The use of a natural seed source may be used under any of the following conditions:

1. Areas that experience flooding that make plantings unlikely to succeed.
2. Depression areas too wet to machine or hand plant.
3. Sites likely to be invaded by soft-mast species that would likely out-compete planted hard mast species.
4. Sites that are within 200 feet of existing mature woodlands and adjacent to desirable seed sources on two sides.

Spacing:

Proper tree and shrub spacing is determined by such factors as the objectives of the planting, species, growth rate, expected thinnings, mortality rates, natural pruning, maintenance of initial site preparation, and planting costs. Therefore, the planner has the option to determine the correct spacing to use with reference to the following guidelines:

- Plant tree seedlings no closer than 6x7. A spacing of 8x8, 8x10, or 10x10 is preferable.
- Plant black walnut and cottonwood on a minimum 10x10 foot spacing
- Virginia pine should not be planted at a spacing wider than 8x8.
- Shrubs – plant on a 6 - 10 foot spacing
- Christmas trees – plant on a 4x4 to 6x6 foot spacing depending on the size of the tree to

be grown and equipment to be used for weed control, etc.

- Wildlife plantings – plant on a minimum of 8x8. Consider equipment that will be used to establish and maintain the planting. Wider spacing than 8x8 allows trees to grow larger crowns, thus producing more branches that will produce more mast and cover. Wider spacing for trees such as 10x10 and 12x12 should be considered.
- Direct seeding – For wildlife habitat development or wetland restoration, a minimum rate of 700 seeds per acre can be used. A rate up to 1500 seeds per acre is recommended to compensate for predation and seedling mortality.
- Containers – Container stock is best suited to sites that have a history of being wet or flooded in spring since they can be effectively planted in fall when bare root seedlings are less available and subject to frost heaving. Large container stock is capable of rapid height growth, allowing it to keep up with fast growing, light seeded bottomland tree species. If natural regeneration is expected to fill in between container trees plant at 28 trees per acre (approximately 40' x 40').

Mixtures:

Pure plantings are easier and more economical to establish, manage, and maintain. Pure stands are also easier to harvest and often result in higher stumpage values. Mixed plantings can produce higher yields and are preferred for wildlife plantings where species diversity is a goal. Hardwoods are more suitable for mixed plantings than pines. Mixtures of hardwoods and pines is not recommended. Use caution in planning mixed hardwood plantings, particularly where timber production is the goal. Following are species mixtures for consideration.

1. Northern red oak and white or green ash with yellow poplar
2. Northern red oak, sweetgum and white or green ash with black walnut
3. Black walnut and yellow poplar in row-group or block mixing

Appendix 3 provides several alternative planting patterns for mixtures

CONSIDERATIONS

When underplanting (planting beneath an already established stand), trees should be planted sufficiently in advance of overstory removal to ensure full establishment. Selection of species and a full understanding and knowledge of shade tolerance characteristics is critical for success.

Use locally adapted seed, seedlings or cuttings. Priority will be given to plant materials that have been selected and tested in tree/shrub improvement programs. All plant materials should comply with a minimum standard, such as those set by the American Nursery and Landscape Association, Forest Service, or a state-approved nursery.

Plans for landscape and beautification plantings should consider foliage color, season and color of flowering, and mature plant height.

Where multiple species are available to accomplish the planned objective, consideration should be given to selecting species which best meet wildlife needs.

Tree/shrub arrangement and spacing should allow for and anticipate the need for future access lanes for purposes of stand management.

Residual chemical carryover should be evaluated prior to planting.

Species considered locally invasive or noxious should not be used.

Species used to treat waste should have fast growth characteristics, extensive root systems, and be capable of high nutrient uptake. They may also produce wood/fiber products in short rotations.

For optimal carbon storage, select plant species that are adapted to the site to assure strong health and vigor and plant the full stocking rate for the site.

PLANS AND SPECIFICATIONS

Specifications for applying this practice shall be prepared for each site and recorded using approved specification sheets, job sheets, technical notes, and narrative statements in the conservation plan, or other acceptable documentation.

Plans and specifications will include the following: adapted tree species for the purposes outlined, spacing, planting methods, cultural practices, maintenance requirements, and variations in methods and species between interplanting, underplanting, and planting in open areas. Separate specifications can be prepared for each of these planting methods.

Reference may be made to planting specifications prepared by the Kentucky Division of Forestry for each component above.

OPERATION AND MAINTENANCE

The following actions shall be carried out to insure that this practice functions as intended throughout its expected life. These actions include normal repetitive activities in the application and use of the practice (operation), and repair and upkeep of the practice (maintenance).

If needed, competing vegetation will be controlled until the woody plants are established. Noxious weeds will be controlled.

A 90% survival rate after three years is considered satisfactory when timber production is the objective if trees are well distributed over the planted area. When wetland restoration, wildlife, and/or water quality are the objectives, a 60% survival rate after three years is considered satisfactory if trees are well distributed over the planted area. The planted areas will be evaluated to determine whether to replant failed spots or if natural regeneration will meet the objectives of the landowner.

The trees and shrubs will be inspected periodically and protected from adverse impacts including insects, diseases or competing vegetation, fire and damage from livestock or wildlife.

Periodic applications of nutrients may be needed to maintain plant vigor.

REFERENCES

"Kentucky Tree Planting Manual", Kentucky Division of Forestry

"Kentucky Forest Practice Guidelines for Water Quality Management", FOR-67, University of Kentucky, College of Agriculture

"Forest Planting Practices In the Central States", Agricultural Handbook 247, USFS

"A Guide For Vegetating Surface-Mined Lands for Wildlife in Eastern Kentucky and West Virginia", U.S. Fish and Wildlife Service, U.S. Department of the Interior

"Species Suitability and pH of Soils in Southern Forests", Forest Management Bulletin, USFS

"Plant Propagation Principles and Practices", third edition, Prentice-Hall, Inc., 1976

"Seeding and Planting Hardwoods", Central Hardwood Notes, USFS

"Seeds of Woody Plants in the United States" Agricultural Handbook No. 450, USFS

USDA, NRCS 1999. The PLANTS database (<http://plants.usda.gov/plants>). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

Appendix 1

Alternative 1: Tree/Shrub and Herbaceous Cover Establishment at the Same Time

Do not use fertilizer with this option.

Mix 10 pounds of orchardgrass with one of the following.

Species	Rate	Seeding Period
Birdsfoot trefoil	10 lbs/acre	March 1 – April 15 August 1 – September 10
Kobe or Korean lespedeza	10 lbs/acre	February 15 – May 15
Red clover	8 lbs/acre	February 1 – April 15 August 1 – September 10
Ladino clover	3 lbs/acre	February 1 – April 15 August 1 – September 15
Appalow lespedeza	20 lbs/acre	February 15 – April 15

Alternative 2: Establish Herbaceous Cover, then Plant Seedlings in Spots

- Seed 15 lbs/ac of orchardgrass; or 10 lbs/ac of redtop between February 1 and April 15 or August 20 and October 10
- Fertilize seeded area with 20 Lbs. N, 40 Lbs. P₂O₅, 60 Lbs. K₂O per acre. Apply 2 tons/acre of lime.
- Use herbicide to kill the herbaceous cover in an area 2 feet around each spot where seedlings will be planted.
- Plant trees in treated spots

Alternative 3: Establish Herbaceous Cover; then Plant Seedlings in Strips

- Seed 15 lbs/ac of orchardgrass, or 10 lbs/ac of redtop between February 1 and April 15 or August 20 and October 10. Fertilize seeded area with 20 Lbs. N, 40 Lbs. P₂O₅, 60 Lbs. K₂O per acre. Apply 2 tons/acre of lime.
- Use herbicide to kill the herbaceous cover in strips where seedlings will be planted. Strips should be 4 – 8 feet wide depending on spacing of the planting.
- Plant trees in strips. If tree planting will be delayed, a second application of herbicide treatment in the strips may be necessary before planting trees.

Temporary Seeding:

If seeding dates for the above mixtures are missed, seed the area with 2 bu./acre spring-sown oats or 3 bu./acre winter-sown oats or 1 bu./acre winter wheat. Destroy temporary cover prior to establishing permanent cover.

Appendix 2

Tree and Shrub Species Suitable for Planting on Mine Spoil

pH 3.6 to 5.5	pH 5.6 to 7.3	pH > 7.3
Ash, green	Ash, green	Ash, green
Ash, white	Ash, white	Cottonwood, eastern
Birch, river	Birch, river	Locust, black
Chestnut, Chinese	Chestnut, Chinese	Poplar, hybrid
Locust, black	Cottonwood, eastern	Russian-olive
Oak, northern red	Locust, black	Redcedar, eastern
Pine, loblolly	Oak, northern red	Sycamore, American
Pine, pitch	Pine, loblolly	Walnut, black
Pine, Scotch	Pine, pitch	
Pine, shortleaf	Pine, Scotch	
Pine, eastern white	Pine, Virginia	
Sweetgum	Poplar, hybrid	
Sycamore, American	Redcedar, eastern	
	Russian-olive	
	Shrub lespedeza	
	Sweetgum	
	Sycamore, American	
	Walnut, black	
	Yellow Poplar	

Appendix 3

PLANTING PATTERNS FOR MIXED SPECIES

- A. Checkerboard pattern of mixing two or more species by blocks; minimum size block should be five rows of five trees.**

NA to Wetland Restoration/Wildlife Plantings

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- B. Row-group pattern for mixing two or more species. Minimum size is 5 rows of the same species to each strip.**

NA to Wetland Restoration/Wildlife Plantings

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- C. Interplanted patterns for mixing two or more species.**

Applicable to Wetland Restoration/Wildlife Plantings

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Appendix 4

Tree and shrub species suitable for wildlife and wetland restoration plantings in Kentucky. Species selection should be based on site characteristics and planting objectives.

Species (Common/Scientific)	Red Or White Oak	Wildlife Merit	Growth Rate	Height at 20 Years	Mature Height (feet)	Regional Indicator Status	Shade Tolerance
Baldcypress <i>Taxodium distichum</i>	-	M	Rapid	45	130	OBL	Intermediate
Dogwood, Red-osier <i>Cornus sericea</i>	-	H	Moderate	5	5	FACW+	Intermediate
Dogwood, Silky <i>Cornus amomum</i>	-	H	Moderate	7	7	FACW	Intermediate
Hickory, Shellbark <i>Carya laciniosa</i> *	-	H	Moderate	35	130	FAC	Tolerant
Holly, Deciduous <i>Ilex decidua</i>	-	M	Moderate	33	33	FACW	Tolerant
Oak, Black <i>Quercus velutina</i> *	Red	H	Moderate	25	90	FACU	Intermediate
Oak, Bur <i>Quercus macrocarpa</i> *	White	H	Slow	25	100	FACU-	Intermediate
Oak, Cherrybark <i>Quercus pagodafolia</i> *	Red	H	Moderate	60	110	FACW	Intermediate
Oak, Chinkapin <i>Quercus muehlenbergii</i> *	White	H	Moderate	30	80	FAC	Intolerant
Oak, Northern Red <i>Quercus rubra</i> *	Red	H	Moderate	36	100	FACU-	Intermediate
Oak, Nuttall <i>Quercus nuttallii</i> *	Red	H	Moderate	40	120	FACW	Intolerant
Oak, Overcup <i>Quercus lyrata</i> *	White	H	Moderate	30	80	OBL	Intermediate
Oak, Pin <i>Quercus palustris</i> *	Red	H	Rapid	40	100	FACW	Intolerant
Oak, Shumard <i>Quercus shumardii</i> *	Red	H	Moderate	40	110	FAC+	Intolerant
Oak, Southern Red <i>Quercus falcata</i> *	Red	H	Slow	35	100	FACU-	Intermediate
Oak, Swamp Chestnut <i>Quercus michauxii</i> *	White	H	Moderate	35	100	FACW	Intolerant
Oak, Swamp White <i>Quercus bicolor</i> *	White	H	Rapid	30	100	FACW+	Intermediate
Oak, Water <i>Quercus nigra</i> *	Red	H	Rapid	30	90	FAC	Intolerant
Oak, White <i>Quercus alba</i> *	White	H	Slow	25	100	FACU-	Intermediate
Oak, Willow <i>Quercus phellos</i> *	Red	H	Rapid	60	100	FAC+	Intolerant
Pawpaw <i>Asimina triloba</i>	-	H	Slow	30	35	FACU	Tolerant
Pecan <i>Carya illinoensis</i> *	-	H	Slow	35	140	FACU	Intolerant
Persimmon <i>Diospyros virginiana</i>	-	H	Moderate	25	50	FAC-	Tolerant
Plum, Wild <i>Prunus sp.</i>	-	H	Moderate	24	24	FACU-	Intolerant
Redbud, Eastern <i>Cercis canadensis</i>	-	M	Slow	16	16	FACU-	Tolerant
Spicebush <i>Lindera benzoin</i>	-	M	Slow	12	12	FACW-	Intermediate
Viburnum, <i>sp.</i>	-	H	Slow	6	6	FACW-	Tolerant
Walnut, Black <i>Juglans nigra</i> *	-	H	Rapid	35	90	FACU	Intolerant
Yellow Poplar <i>Liriodendron tulipifera</i>	-	M	Rapid	50	120	FACU	Intolerant

* - Hard Mast Species; H = high; M = medium; L = low

NRCS, KY

September 2003

Indicator categories:

OBL	Obligate Wetland	Occurs almost always (estimated probability 99%) under natural conditions in wetlands.
FACW	Facultative Wetland	Usually occurs in wetlands (estimated probability 67%-99%), but occasionally found in non wetlands.
FAC	Facultative	Equally likely to occur in wetlands or non-wetlands (estimated probability 34%-66%).
FACU	Facultative Upland	Usually occurs in non-wetlands (estimated probability 67%-99%), but occasionally found on wetlands (estimated probability 1%-33%).
UPL	Obligate Upland	Occurs almost always (estimated probability 99%) under natural conditions in non-wetlands
NA	No agreement	The regional panel was not able to reach a unanimous decision on this species.
NI	No indicator	Insufficient information was available to determine an indicator status.

Regional Indicators express the estimated probability (likelihood) of a species occurring in wetlands versus non-wetlands in the region. Regional Indicators reflect the unanimous agreement of the Regional Interagency Review Panel.

The positive sign indicates a frequency toward the higher end of the category (more frequently found in wetlands), and a negative sign indicates a frequency toward the lower end of the category (less frequently found in wetlands).

The wetland indicator categories should not be equated to degrees of wetness. Many obligate wetland species occur in permanently or semi-permanently flooded wetlands, but a number of obligates also occur in and some are restricted to wetlands which are only temporarily or seasonally flooded. The facultative upland species include a diverse collection of plants, which range from weedy species adapted to exist in a number of environmentally stressful or disturbed sites (including wetlands), to species in which a portion of the gene pool (an ecotype) always occurs in wetlands. Both the weedy and ecotype representatives of the facultative upland category occur in seasonally and semi-permanently flooded wetland.